

Development and Application of Hyperspectral Infrared Ozone Retrieval Products for Operational Meteorology

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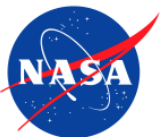
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Transitioning unique data and research technologies to operations



Outline

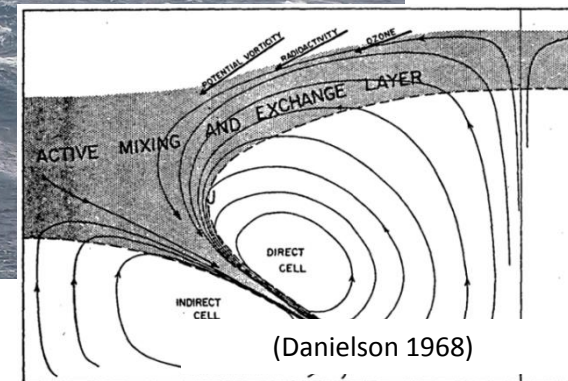
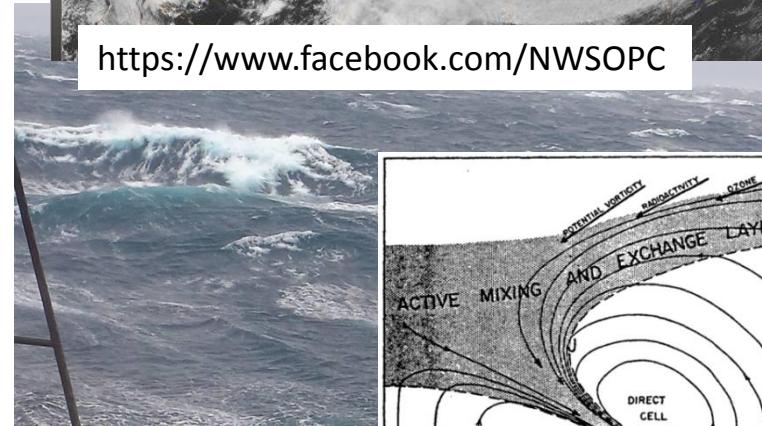
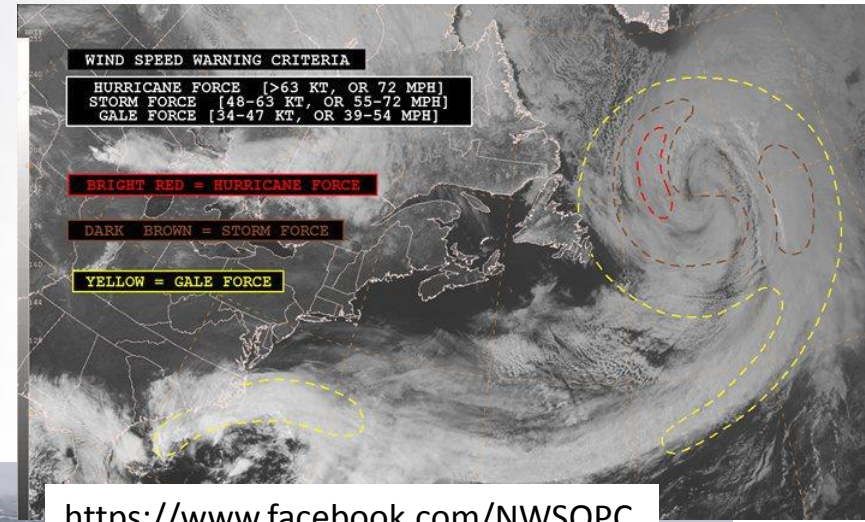
- Forecast Challenge & Ozone Retrievals
- Ozone Products
- Transition to National Centers
- New Product Development

The objective of this presentation is to:

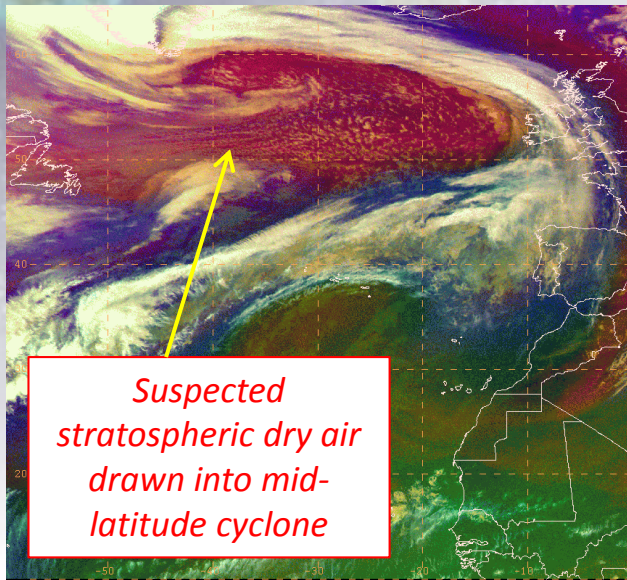
- *show work that SPoRT has done to transition AIRS ozone retrievals in preparation for advanced sounder instruments on operational NOAA satellites (i.e., CrIS)*
- *help forecasters with interpretation of Air Mass RGB imagery that is currently available from SEVIRI and will be available from GOES-R ABI*

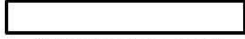







Forecast Challenge & Ozone Retrievals

- WPC & OPC are tasked with providing outlooks that involve forecasting the development of synoptic scale systems and associated severe weather
- OPC especially focuses on forecasting cyclogenesis and the development of hurricane-force winds in the North Pacific and Atlantic oceans
- Identifying regions of stratospheric air and the potential for tropopause folding can enhance forecaster situational awareness of impending cyclogenesis and high wind events
- Stratospheric air can be identified by potential vorticity and warm, dry, ozone rich air



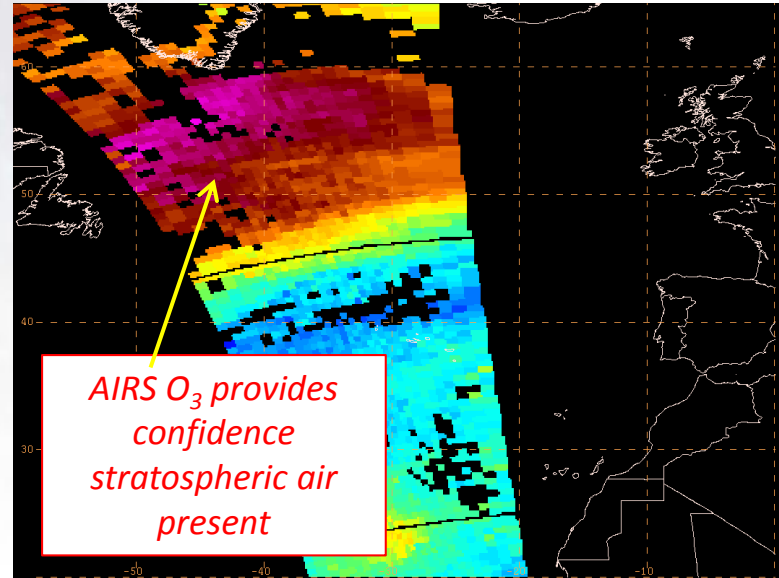
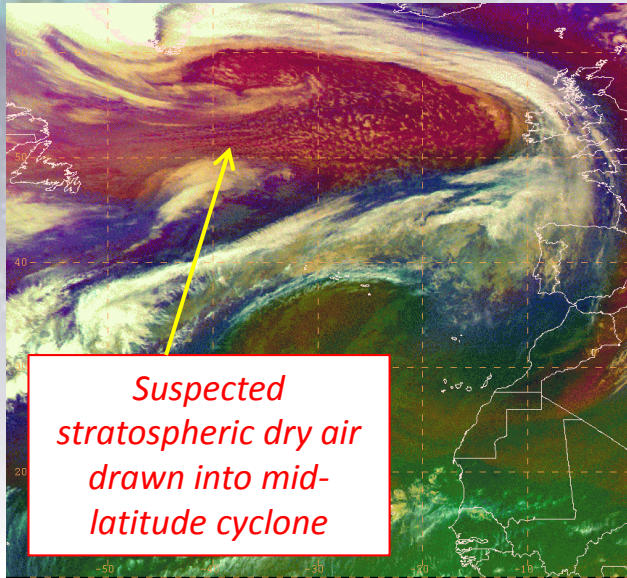
Forecast Challenge & Ozone Retrievals



Interpretation of Colors	
Cloudy Skies	Clear Skies
 Thick, high-level cloud	 Jet (high PV)
 Thick, mid-level cloud	 Cold air mass
 Low-level cloud (Cold air mass)	 Warm air mass (High Upper Tropospheric Humidity)
 Low-level cloud (Warm air mass)	 Warm air mass (Low Upper Tropospheric Humidity)
(Zavodsky et al. 2013 adapted from http://oiswww.eumetsat.int/~ids/html/doc/air_mass_interpretation.pdf)	

- OPC has used the SEVIRI, MODIS, and GOES Sounder Air Mass RGB products as a proxy to prepare for GOES-R ABI capabilities
- Regions of red/orange coloring can indicate stratospheric air and the potential for tropopause folding, enhanced cyclogenesis and associated hurricane-force wind events
- Forecasters and product developers have expressed a need for quantitative products to enhance understanding and training of the qualitative RGB

Forecast Challenge & Ozone Retrievals



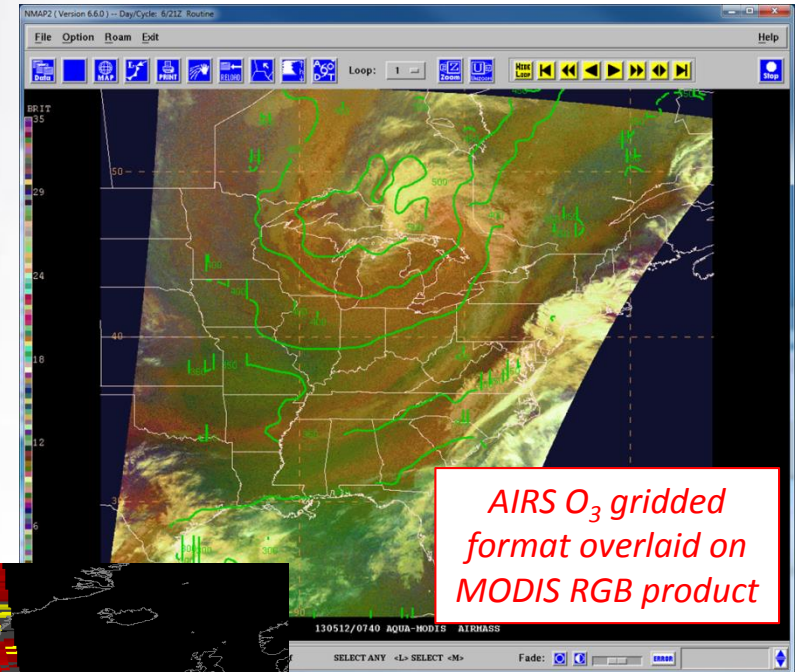
- SPoRT has worked closely with the GOES-R and JPSS Proving Grounds to develop and transition ozone products in N-AWIPS format to OPC for identification of stratospheric air/tropopause folds that lead to cyclogenesis and high wind events
- Legacy AIRS ozone retrievals can be used to enhance interpretation and increase forecaster confidence in the Air Mass RGB before GOES-R launch as well as demonstrate capabilities of next-generation JPSS CrIS retrievals

Outline

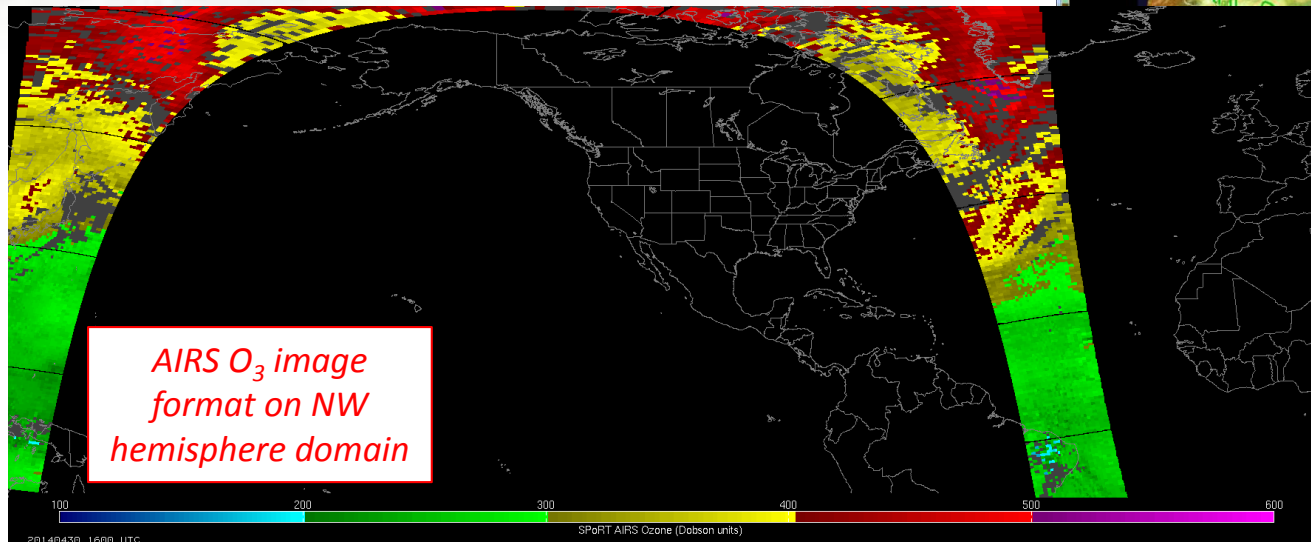
- Forecast Challenge & Ozone Retrievals
- **Ozone Products**
- Transition to National Centers
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What products does SPoRT create?

- SPoRT produces 2 products in image and gridded format:
 - Total Column Ozone
 - Ozone Anomaly
- AIRS data obtained from NASA Land Atmosphere Near Real-time Capability for EOS (LANCER) with latency between 60 and 200 minutes

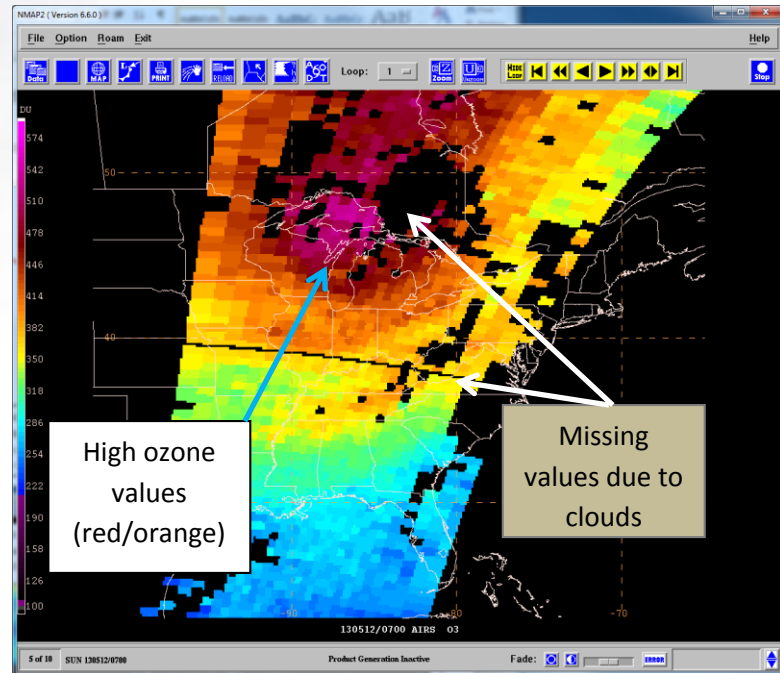
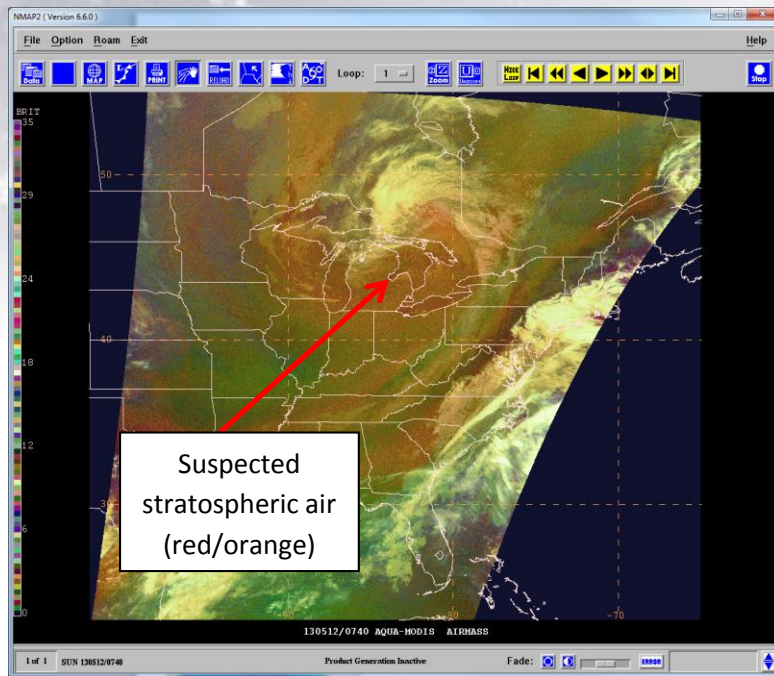


- Product is provided in hourly swaths:
 - Products have a 4-hour latency to utilize all granules
 - Advantage is hemispheric coverage for OPC's domain



Example 12 May 2013

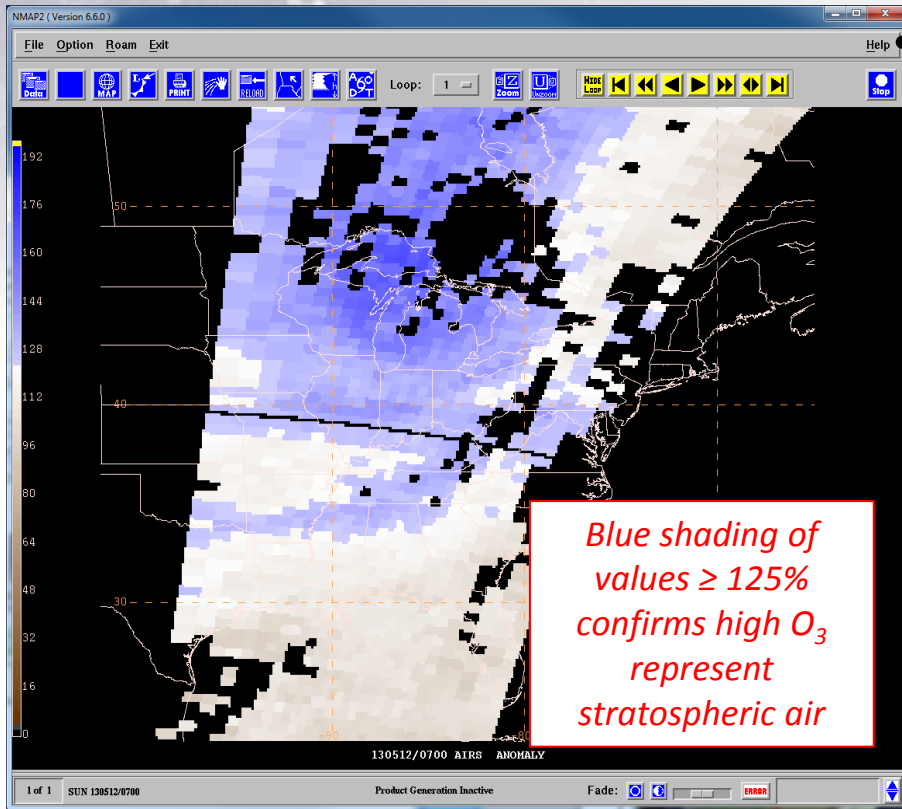
- SPoRT MODIS RGB Air Mass Image shows a region of red/orange coloring surrounding the low pressure center
- AIRS Total Column Ozone confirms there are high ozone values in the region



- How do we know if these high ozone values represent stratospheric air or are within the climatological range?

Ozone Anomaly Product

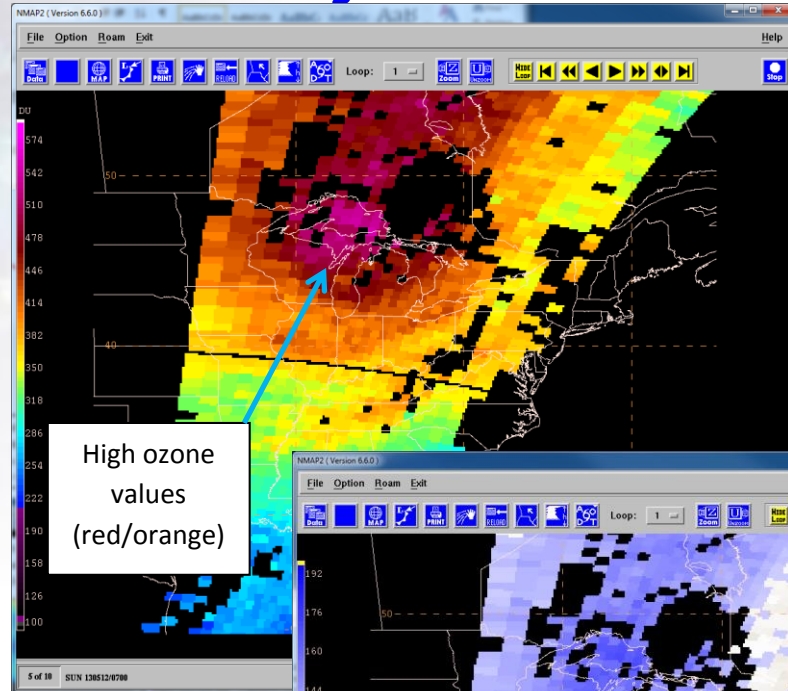
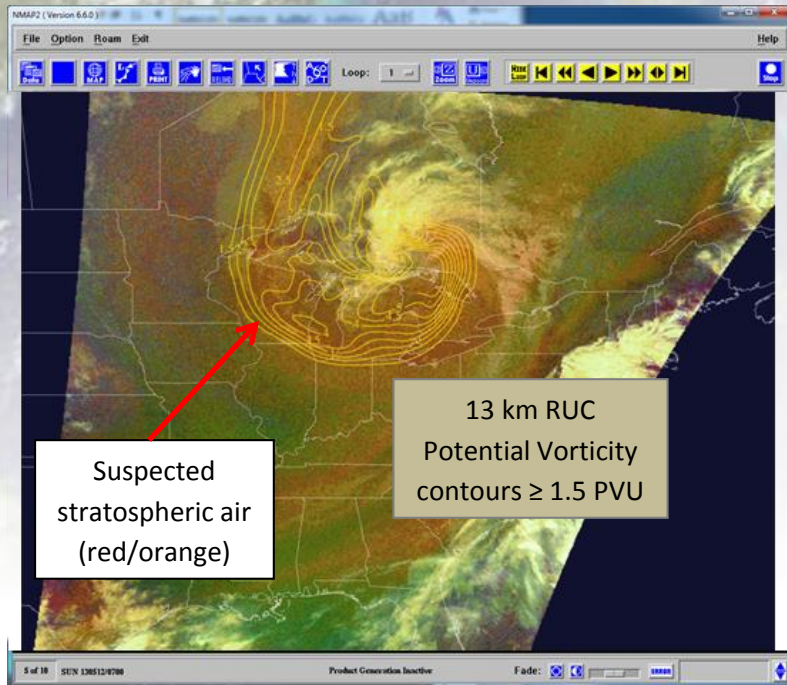
- Identification of stratospheric air based on high ozone values could lead to misinterpretation if the values actually range within climatology since the mean varies seasonally and spatially



The AIRS Ozone Anomaly product clarifies the presence of stratospheric air based on:

- Stratospheric air has ozone values at least 25% larger than the climatological mean (Van Haver et al. 1996)
- Global and zonal monthly mean climatology of stratospheric ozone derived from the NASA Microwave Limb Sounder (Ziemke et al. 2011)

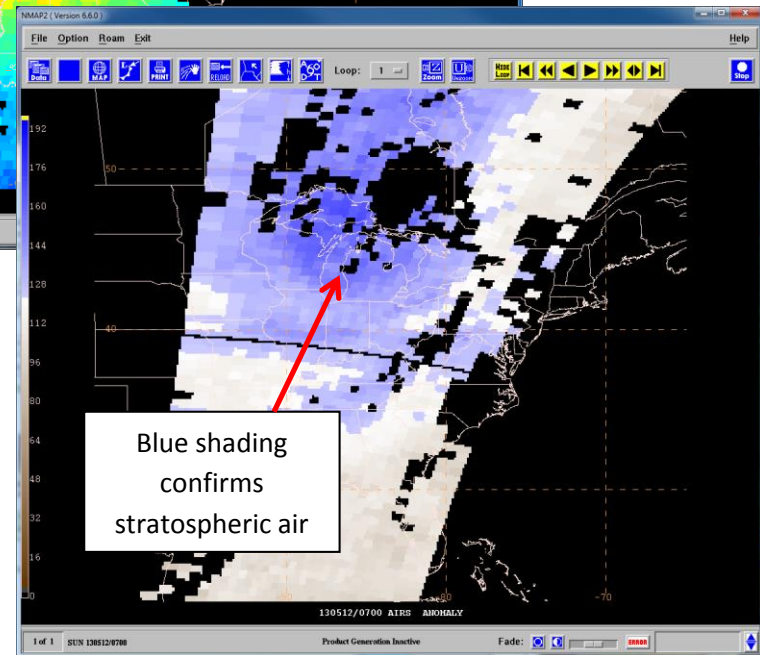
Example 12 May 2013



- SPoRT AIRS Ozone Anomaly product created as a percent of normal (0-200%)

$$PON = \frac{TCO}{climo} \times 100$$

- Shades of blue represent stratospheric air (ozone values $\geq 125\%$)

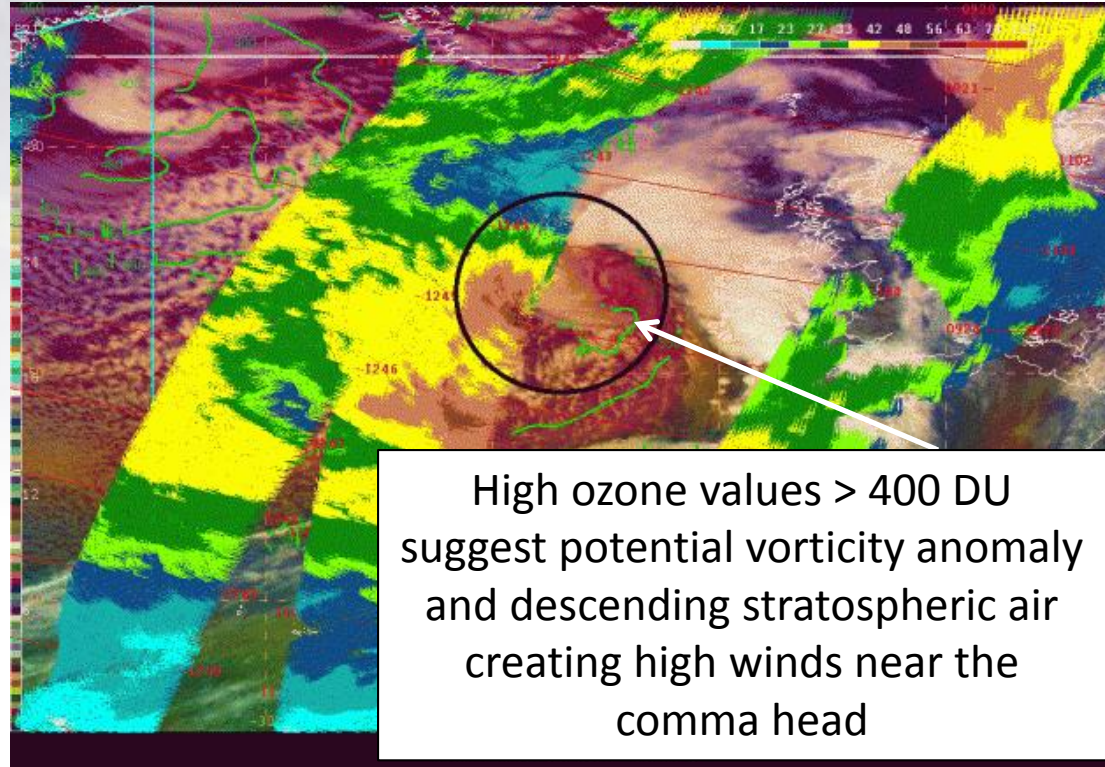


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Transition to National Centers

- AIRS ozone products evaluated at OPC, WPC, SAB winter 2013-2014
- Forecaster Feedback
 - “Reinforce the evidence from RGB of the descent of stratospheric air with tropopause folding.”
 - “This has allowed me to have confidence in assessing the RGB Airmass product and also in conjunction with gridded GFS output that a perceived PV anomaly is real or not.”



SEVIRI RGB Air Mass image, AIRS Total Column Ozone (green contours), and ASCAT winds valid at 1400 UTC on 12/18/13. The black circle highlights the descending stratospheric intrusion near the comma-head/bent back front. Image courtesy of Michael Folmer Satellite Liaison at NOAA/NWS WPC/OPC/TAFB and NOAA/NESDIS SAB

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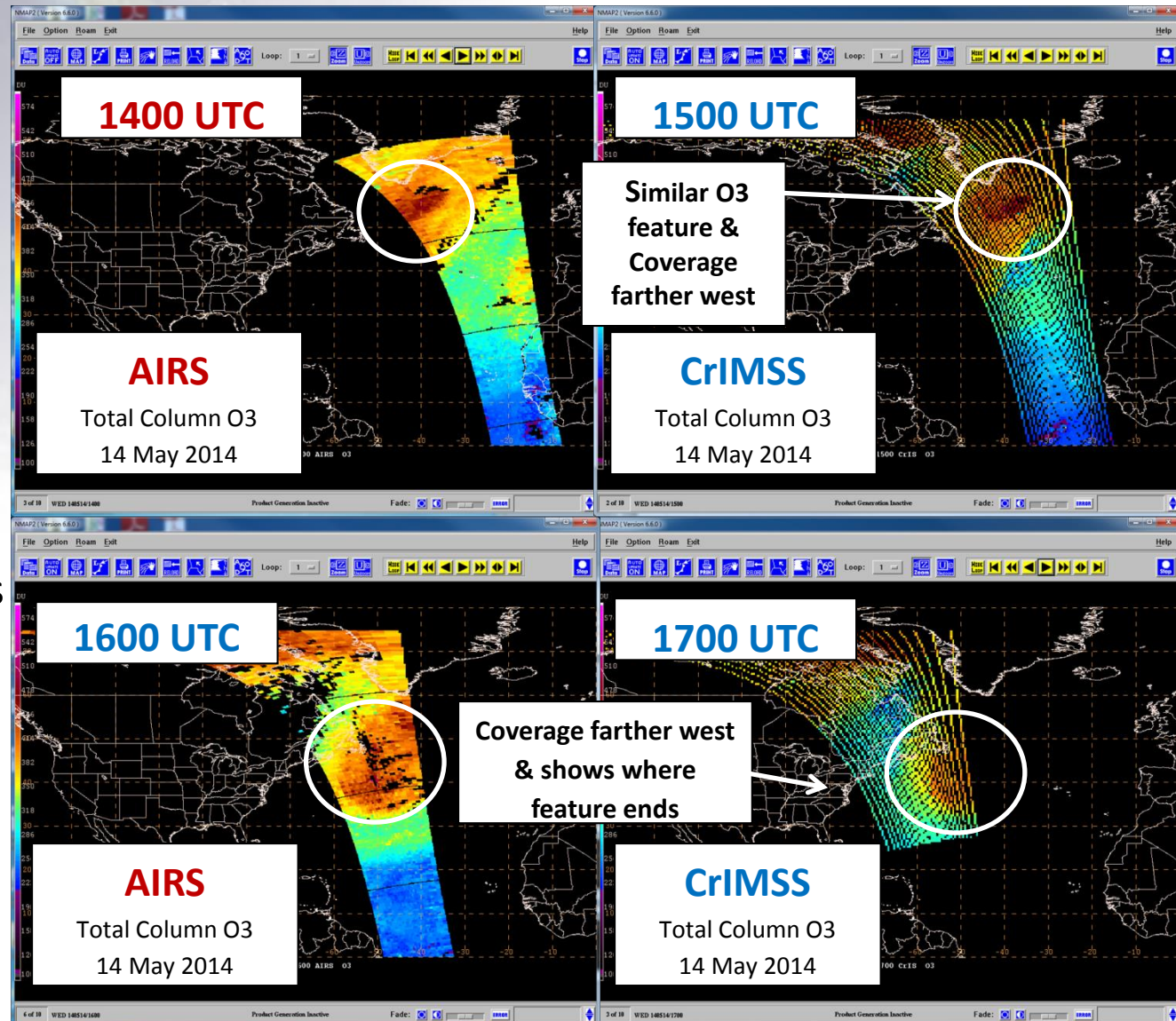
New Product Development

- Adjust product according to forecaster feedback from the winter 2014 product demonstration at OPC
- Expand the ozone products to other instruments
 - Increase temporal & spatial coverage by developing products from IASI and CrIS retrievals

“There may have been 1 occasion where 1 pass did line up over the US with the spot I was interested in. In that case, it was helpful in reaffirming my suspicions on whether stratospheric air was present. Otherwise, the passes were few and far between and not particularly timely. If there was greater coverage of passes and not as much of a lag, it would certainly be useful.”

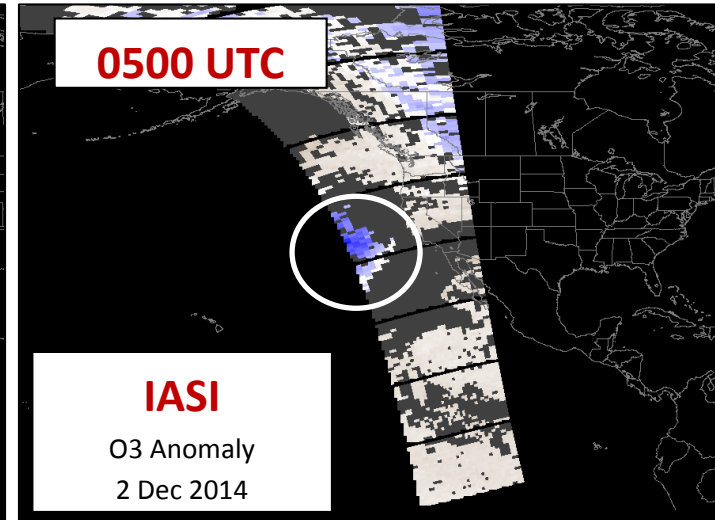
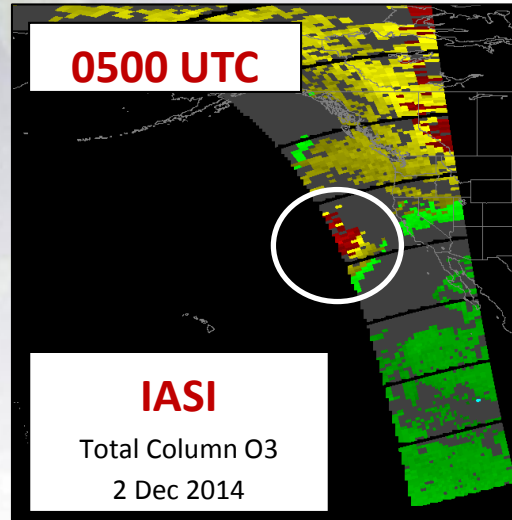
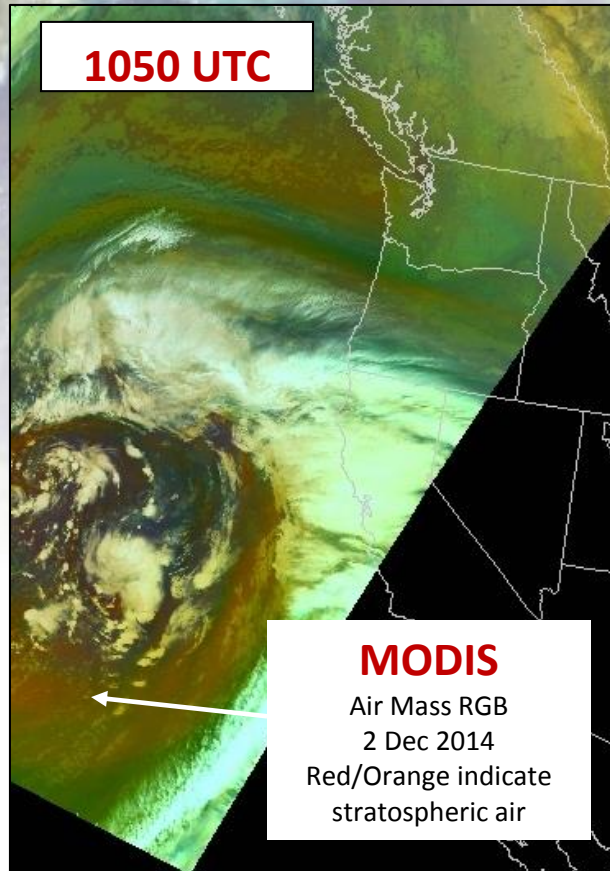
CrIS Ozone Products

- A forecaster could potentially loop through 4 consecutive time periods of data
- Demonstrates increased temporal coverage available from GOES-R ABI
- Spatial coverage over the 4 hour period now includes most of the North Atlantic
- Shifting product development to NUCAPS



Transitioning unique data and research technologies to operations

IASI Ozone Products



- IASI overpass available for analysis with the 1050 MODIS overpass
- Next AIRS 1000-1100 UTC overpass not available to compare to MODIS due to latency
- IASI products provide more orbit times for forecasters to analyze
- Plan to transition to National Centers early 2015



Questions & Comments

Email any additional feedback or comments
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